Program Name : **Diploma in Automobile Engineering**

Program Code : **AE**

Semester : **Fifth**

Course Title : **Automobile Body Engineering and Safety (Elective)**

Course Code : **22561**

1. RATIONALE

As a supervisor or self-employed, the diploma technician is supposed to fabricate and repair various vehicle bodies. The knowledge and skills of vehicle body technology and safety is required to manage vehicle body fabrication and repair. In the automotive field auto body repair is experiencing a faster growth compared to other service areas. Collision repair plus the normal up-keep of the automobile body requires increasing numbers of well-trained auto body technicians. This course is designed to provide students the required level of knowledge and skills of vehicle body technology. There are lots of employment opportunities in car dealerships as well as body building workshops.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Follow safe practices in production and maintenance of auto bodies.**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following ***industry oriented*** COs associated with the above mentioned competency:

a. Select relevant auto body for different applications.
b. Check the streamlining/profiling of auto body.
c. Use relevant materials for automobile body and refinishing work.
d. Maintain tools and equipment for body repair.
e. Repair the damaged auto bodies.
f. Maintain security systems of vehicles.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory							Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment*

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

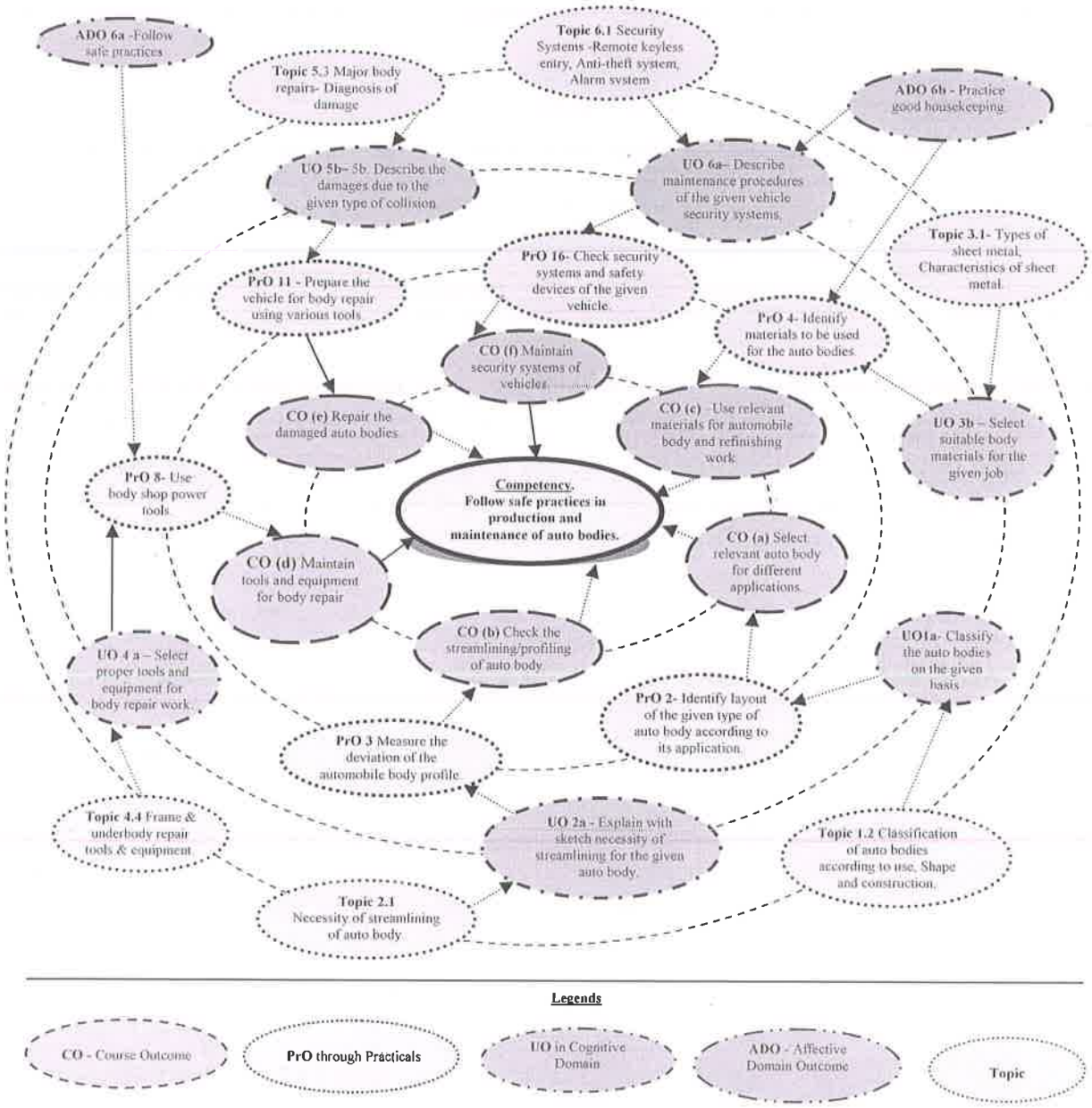

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Identify the components of the given auto body.	I	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
2.	Identify layout of the given type of auto body according to its application (e.g car body, LMV- Passenger and transport vehicle body, Bus body).	I	02*
3.	Measure the deviation of the automobile body profile.	II	02*
4.	Identify materials to be used for the auto bodies and justify their application.	III	02*
5.	Use of the refinishing materials in the body repair shop and record their specifications.	III	02
6.	Identify the types of fasteners used in auto body manufacturing and justify their application.	III	02*
7.	Use of basic hand tools available in body shop and write their specification.	IV	02*
8.	Use body shop power tools.	IV	02
9.	Use denting tools.	IV	02*
10.	Use painting tools and equipment and record their specifications.	IV	02
11.	Prepare the vehicle for body repair using various tools.	V	02
12.	Restore the damaged body using various tools	V	02*
13.	Prepare repaired body for refinishing using various tools	V	02*
14.	Replace the damaged body panel using various tools	V	02*
15.	Restore the Interior/Exterior trim, Upholstery, Body insulation and sealing.	V	02
16.	Check the security systems and safety devices of the given vehicle.	VI	02*
	Total		**32**

Note

i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
a.	Follow safety rules and adopt standard practices for handling tools and equipment's.	30
b.	Refer workshop manual and include relevant data in the journal.	20
c.	Sketching layouts, components and conclusion.	20
d.	Answer to sample questions	20
e.	Submit report in time	10
Total		**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Work as a leader/a team member.
d. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year and
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	Pro. S. No.
1.	Body of Car: A used Car Body of any model (above 1000 cc) and make like Maruti, TATA along with all relevant accessories in good working condition.	All
2.	Body of Light Motor Vehicle – Body of hard top Jeep of any model (minimum 1400 cc) and make like TATA Motors Ltd., Mahindra and Mahindra Ltd., Force Motors Ltd., etc. along with all relevant accessories in good working condition.	All
3.	Denting tools and equipment- Basic denting tools like 1. Hammers (Weight ¼ kg to 2 kg): General purpose pick hammer, Bumping hammer, Cross-Peen hammer, Cross-Chisel hammer, Pick Fin hammer, Cross Chisel shrinking hammer, Dinging hammer, Door Skin hammer, Trim hammer. 2. Dolly blocks: Long handle spoon dolly, Caulking Iron, General Purpose Dolly, Shrinking Dolly, Anvil Dolly, Dome Dolly, Round Forming Dolly, Oblong Dolly, Heel Shaped Dolly, Curved Dolly, Toe-shaped Dolly, Shrinking Body dolly, Wedge Shaped Dolly, Egg Shaped Dolly. 3. Dent Pullers: Pneumatic type (Vacuum based) or Spot - weld type. 4. Spoons: Light dinging spoon, Slapping spoon, General purpose fender spoon 5. Pick bars: Medium short curved picks. 6. Chisels: Metal Chisel - **Blade Width (mm)**: 6-7mm, **Surface Treatment**: Polished, **Size (Inch)**: 4 Inch, **Structure**: Straight, **Finish**: Mat., 7. Files: Simple flat & round metal files, Special flexible Vixen files. 8. Blow Lamp: Material Used: Brass & Iron Steel, Additional Name: Brass Pressure Kerosene Blow Lamp, Application/Use: Heating 9. Soldering equipment: Voltage:110V, Wattage:60W, Wire Capacity:0.8 to 2mm or any other suitable specifications. 10. Buffing and Polishing machines: For sanding, polishing and buffing.	11, 12

S. No.	Equipment Name with Broad Specifications	Pro. S. No.
	Variable speed control. Large loop handle for operator control. Output shaft M14 male. Pad size 180 mm. No load speed 600-3,000 rpm.	

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Vehicle Body Construction	1a Classify the auto bodies on the given basis. 1b Sketch a labeled auto body for the given application. 1c Select an auto body for the given application with justification. 1d Describe with sketch the constructional details of the given auto body.	1.1 Introduction to Auto body- Purpose and requirements of auto body. 1.2 Classification of auto bodies according to use (e.g Car body, Bus body, Truck body, Oil/Milk Tanker etc.), Shape (Sedan, convertible, Hatch back, Nose back) and construction (Conventional and Unitized). 1.3 Body structure – Major parts and constructional details of car body. 1.4 Layout and constructional details of bus body and truck body according to type of chassis.
Unit– II Body Aerodynamics	2a Explain with sketch necessity of streamlining of the given auto body with justification. 2b Calculate the aerodynamic drag and lift forces acting on the given auto body with the given data. 2c Explain with sketch the effect of aerodynamic drag on performance of the given type of vehicle. 2d Describe with sketch the process of auto body test for the given condition.	2.1 Necessity of streamlining of auto body. 2.2 Concept of aerodynamic drag, drag coefficient, Formation of eddies. 2.3 Effects of aerodynamic drag on vehicle performance. 2.4 Body testing – Collision test, NVH test, Roll over test, Impact test, Wind tunnel testing.
Unit III Body Materials	3a. Select the relevant sheet metal for the given body with justification. 3b. Select suitable body materials for the given job with justification. 3c. Select relevant body refinishing materials with justification.	3.1 Types of sheet metal, Characteristics of sheet metal. 3.2 Timber 3.3 Types of glass. 3.4 Types of Resins, Characteristics of resins. 3.5 Plastic parts 3.6 Composite materials GRP (Glass reinforced plastic), FRP (Fiber

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	3d. Identify the fasteners used in the given body with justification.	reinforced plastic). 3.7 Types of paints. 3.8 Body refinishing materials – Fillers, Primers, Sealers, Additives, Sand Paper and other compounds common to body shop. 3.9 Fasteners.
Unit-IV Body Repair Tools and Equipments	4a. Select proper tools and equipment for body repair work with justification. 4b. Describe the procedure to maintain the given equipment required for repair and refinishing of auto body. 4c. State the specifications of the the tools and equipment required for the given job. 4d. State safety precautions to be taken while handling body shop equipments with justification.	4.1 Basic hand tools 4.2 Power tools. 4.3 Body shop equipment's 4.4 Frame & underbody repair tools & equipment. 4.5 Electronic straightening & measurement system. 4.6 Denting tools and equipments. 4.7 Painting equipment and accessories.
Unit –V Minor and Major Body Repairs	5a. Select relevant method for the given minor body repairing with justification. 5b. Describe the damages due to the given type of collision. 5c. Describe the repair method for the given material with justification. 5d. Describe the procedure for panel replacement of the given vehicle body. 5e. Suggest the relevant surface preparation/preventive treatment for refinishing of the given body condition with justification. 5f. Select relevant painting method for the given job with justification. 5g. Describe repair method of trims, insulation and upholstery for the given body.	5.1 Types of minor body repairs-repair with washer welder, repair with hammer & dolly, panel filling with plastic body and filler –forming with solder, panel shrinking (drawing operation). 5.2 Repairing of rusted body panels. 5.3 Major body repairs- Diagnosis of damage, Front end collision, Rear end collision, Side swipe collision. 5.4 Roll-over damage. 5.5 Fibre glass repairs & replacement. 5.6 Body aligning. 5.7 Panel replacement. 5.8 Preventive and anti-corrosive treatments. 5.9 Painting methods and techniques. 5.10 Painting defects and their diagnosis. 5.11 Miscellaneous Body services - Interior trim and upholstery, Glass and door service, Body insulation and sealing, Exterior trim.
Unit –VI Safety	6a. Describe maintenance procedures of the given vehicle	6.1 Security Systems -Remote keyless entry, Anti-theft system, Alarm

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Features and Devices	security systems. 6b. Describe utility and functions of GPS system for the given vehicle. 6c. Explain the necessity and types of seat belts for the given vehicle application. 6d. Explain with sketches the working of the given type of Air bag.	system. 6.2 Entertainment and peripheral systems – Integrated communications, Proximity sensors. 6.3 Global positioning satellites (GPS). 6.4 Seat Belts, Seat Belts pre-tensioners, Smart seatbelt reminder. 6.5 Concepts of Crash test, Crash sensors. 6.6 Air bags - Introduction of air bags, Duel stage air bags, Side Airbags. 6.7 Tyre pressure monitoring system. 6.8 Pedestrian Protection & Night vision with pedestrian detection.

***Note**: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Vehicle Body Construction	06	--	04	04	08
II	Body Aerodynamics	06	02	04	04	10
III	Body Materials	06	02	02	06	10
IV	Body Repair Tools and Equipments	06	02	02	06	10
V	Minor and Major Body Repairs	16	02	04	14	20
VI	Safety Features and devices	08	02	04	06	12
Total		**48**	**10**	**20**	**40**	**70**

***Legends:** R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*

***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed in laboratory.
b. Give seminar on relevant topic.
c. Undertake micro-projects.

d. Search latest advanced safety devices used in automobiles and collect their specifications.
e. Collect data regarding different tools and equipments used in body repair shop.
f. Collect data regarding different tools and equipments used in paint shop.
g. Sketch the body shapes as per aerodynamic requirements.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item ***activities***.
e. Guide student(s) in No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular***
f. Undertaking micro-projects.
g. Demonstrate students thoroughly before they start doing the practice.
h. Encourage students to refer different websites to have deeper understanding of the subject.
i. Observe continuously and monitor the performance of students in Lab.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Body sketches and features: Sketch 10 different vehicle bodies for various applications. Specify relevant features of the same bodies. Suggest two body designs for given application (example- ambulance, milk van, garbage truck, petroleum carrier).
b. Case study of an automobile body aerodynamics: Drag reduction techniques, body profile, and aesthetics.
c. Clay model of a car: Prepare a clay model of a car. Carry out wind tunnel test of the model.

d. Body test and its interpretation: Refer standard procedure to conduct the relevant test and interpret the test result. Minimum two tests to be reviewed.
e. Body materials and their properties: Prepare a display board of collected samples of body material and their relevant properties; prepare a list of manufacturers for the same.
f. Body Preparation for paint work: Detailed procedure to carry out body preparations for painting- Surface preparation and primer application.

13. SUGGESTED LEARNING RESOURCES :

S. No.	Title of Book	Author	Publication
1	Vehicle body engineering	Pawlowski, J.; Tidbury, G.H.	Century Publications,Century,1970 ISBN-13: 978-0220689162
2	The Principles of Auto body repairing and Repainting	Andre, G. Deroche	Prentice Hall, Inc. London,1976 ISBN-13: 978-0134400334
3	Motor Auto Body Repair,	Robbert, Scharff; James E., Duffy	Delmar Publishers, (ITP company),1998 ISBN – 827368585
4	Automobile Engineering	Ramlingam, K.K.	Scitech Publication, Delhi, 2011 **ISBN-13:** 978-8188429486
5	Automobile Engineering Vol.5 Paint Techniques	Chikara, Anil	Satya Prakashan ,New Delhi, 2015, 1st Editon, **ISBN** 13 : 9788176840774
6	Automobile Engineering	Gupta, R.B.	Satya Prakashan, New Delhi, 2015 **ISBN**: 9788176848589,
7	Automotive Mechanics	William H, Crouse; Anglin, Donald L	McGraw- Hill Publication, 2017 SKU:-OBS/2017/02/18/684
8	Automobile Engineering	Narang, G.B.S.	Khanna Publication, Delhi,1989 **ISBN:** 1234567144518
9	Automobile Mechanics	Giri, N. K.	Khanna Publication, Delhi,2014, 8th Edition, ISBN 13: 9788174092168

14. SOFTWARE/LEARNING WEBSITES

a. https://www.youtube.com/watch?v=Pgpawejpi6o – Wind Tunnel testing
b. https://www.youtube.com/watch?v=fKy9YwfLQ6U – Painting procedure of a car
c. https://www.youtube.com/watch?v=ru4JIZ-x8yo – Antilock braking system
d. https://www.youtube.com/watch?v=R4ekbB5EzZM – Air bag and seat belt operation
e. https://www.youtube.com/watch?v=gcKx2ZqhlcU
f. https://www.youtube.com/watch?v=ORFa_iPtAeY
g. https://www.youtube.com/watch?v=I3OIxtpWX7Y
h. https://www.youtube.com/watch?v=t4TdwcPbEiE
i. https://www.youtube.com/watch?v=u0IJjKh-dWE
j. https://www.youtube.com/watch?v=LtwX8rrcEUQ
k. https://www.youtube.com/watch?v=SnDCcnzQapo&list=PL91B84909AEC3F3E4
l. https://www.youtube.com/watch?v=A3Cw58U0I4Q&list=PL91B84909AEC3F3E4
m. https://www.youtube.com/watch?v=qUehclZVeIs


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